

Non-SUSY Searches at the Tevatron

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on behalf of the CDF and D \emptyset Collaborations

MOTIVATION

Why look for alternatives to SUSY?

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No truly compelling argument for any given model
→ signature-based searches

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This talk: recent Tevatron searches with $1\text{--}2.9 \text{ fb}^{-1}$ of data
convey sensitivity with specific interpretations
but broadly sensitive to multiple models

$e e, \mu \mu, \gamma \gamma$
photons/jets+MET
 $Z \gamma, W W/Z, Z Z$

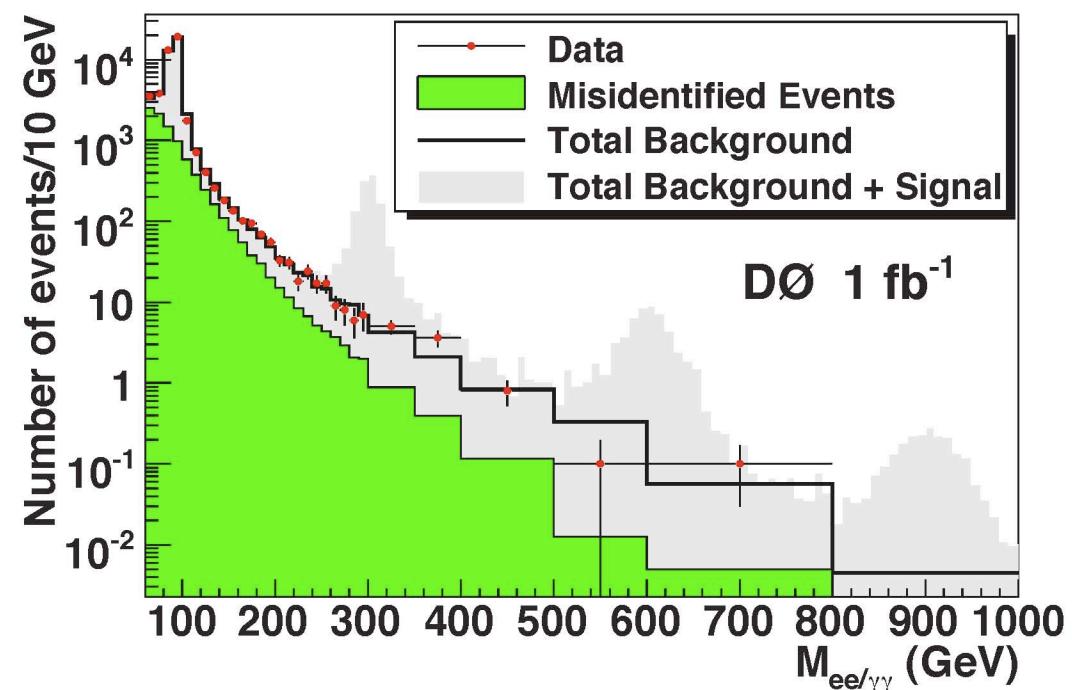
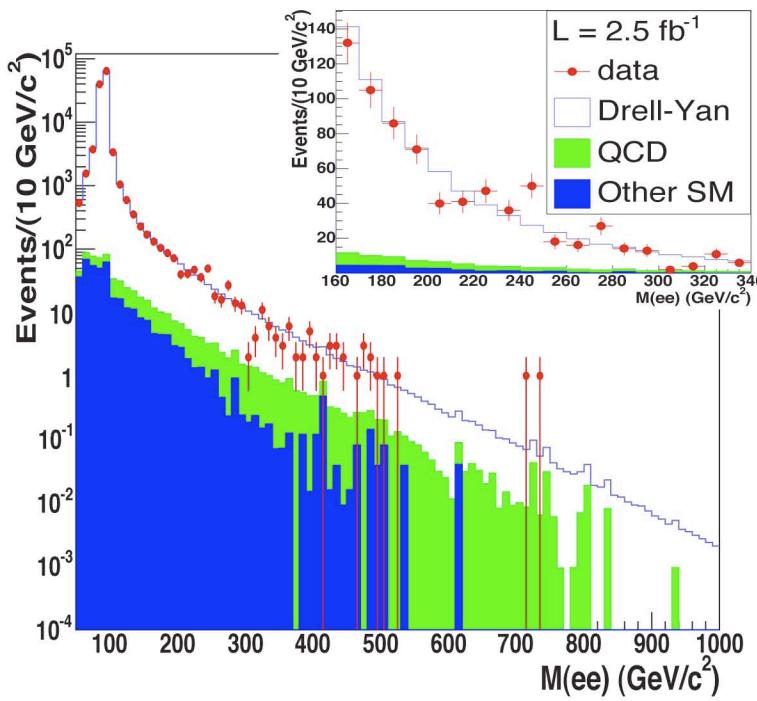
Z' SEARCHES

Archetypal signature-based search

Look for bump in tail of dilepton invariant mass spectrum

CDF ($X \rightarrow ee$)—excess at ~240 GeV ($p=0.6\%$ for 0.15–1 TeV)

DØ ($X \rightarrow ee/\gamma\gamma$)—no significant excess at any mass

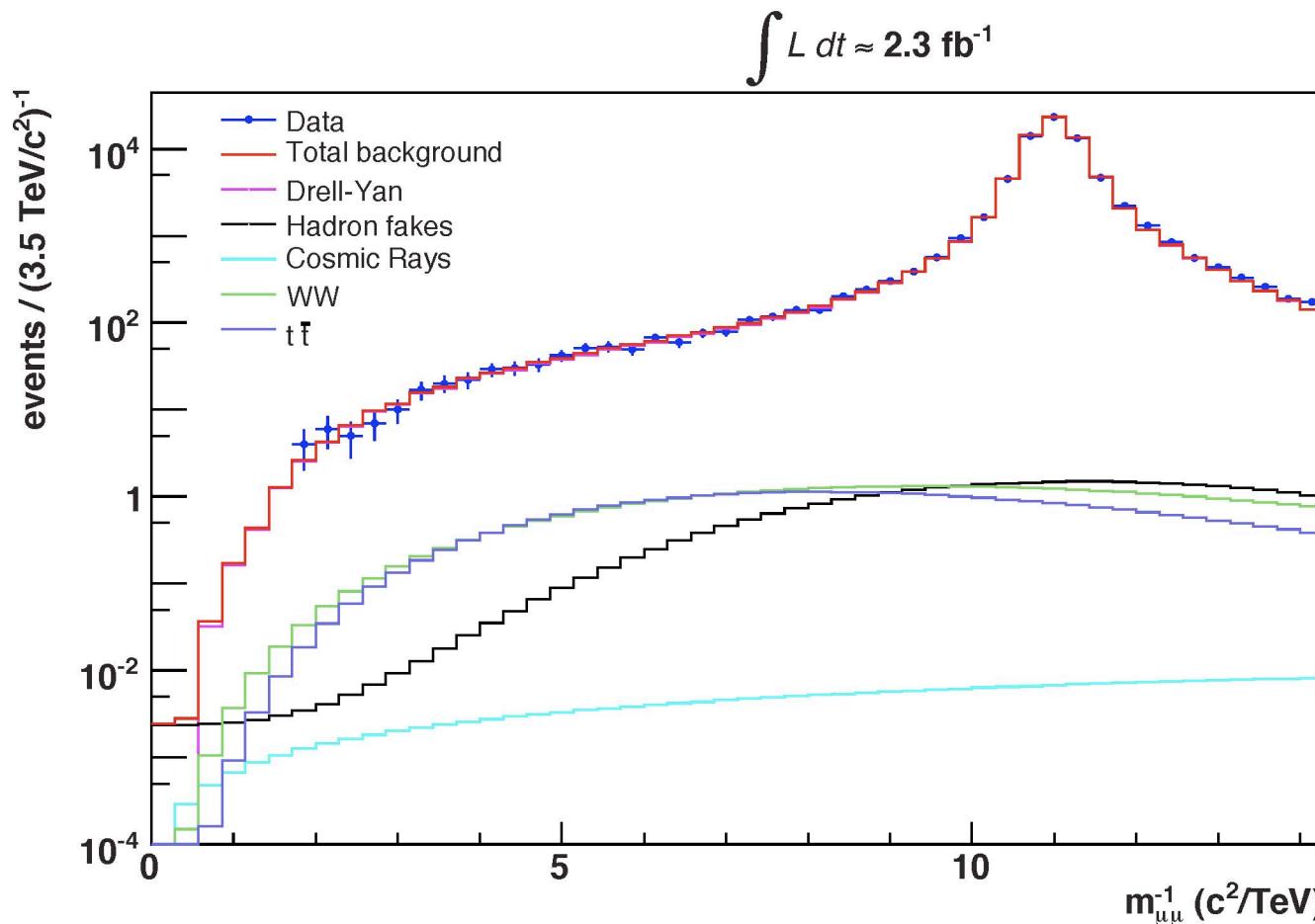


Z' SEARCHES

Archetypal signature-based search

Look for bump in inverse dilepton invariant mass spectrum

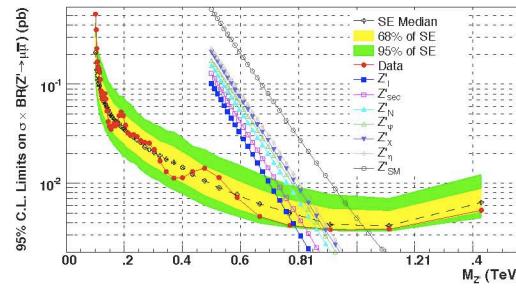
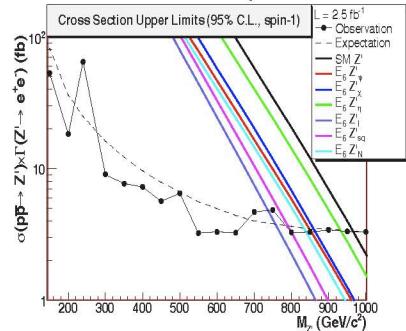
CDF ($X \rightarrow \mu\mu$)—no significant excess at any mass



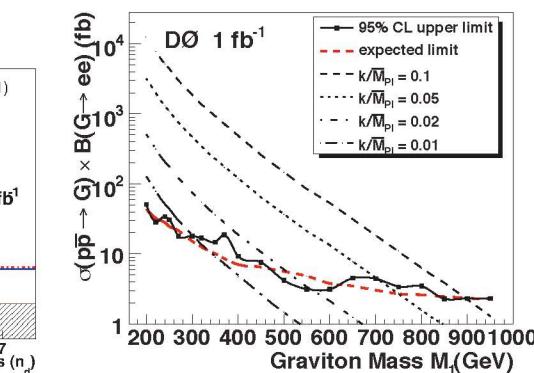
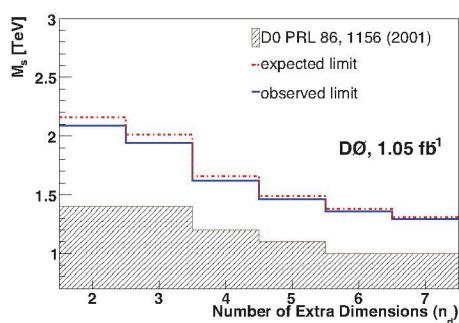
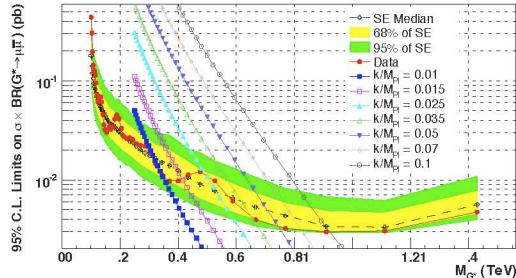
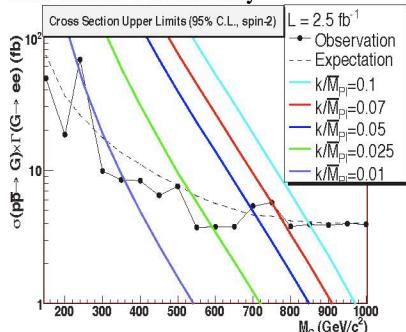
Z' SEARCHES

Archetypal signature-based search
Probe many types of models

CDF Run II Preliminary



CDF Run II Preliminary



EXAMPLE LIMITS
(95% CONFIDENCE)

SM-like (spin 1) $Z' \rightarrow ee$
 $M > 965 \text{ GeV}$ (CDF, 2.5 fb^{-1})

SM-like (spin 1) $Z' \rightarrow \mu\mu$
 $M > 1030 \text{ GeV}$ (CDF, 2.3 fb^{-1})

RS (spin 2) $G \rightarrow \gamma\gamma, ee$
 $M > 900 \text{ GeV}$ ($D\emptyset, 1 \text{ fb}^{-1}, k/M_p = 0.1$)

RS (spin 2) $G \rightarrow \mu\mu$
 $M > 921 \text{ GeV}$ (CDF, $2.3 \text{ fb}^{-1}, k/M_p = 0.1$)

ADD (spin 2 continuum) $G \rightarrow \gamma\gamma, ee$
 $\frac{M}{M_p} > 2.09 \text{ TeV}$ ($D\emptyset, 1.05 \text{ fb}^{-1}, n=2$)
 $\frac{M}{M_p} > 1.29 \text{ TeV}$ ($D\emptyset, 1.05 \text{ fb}^{-1}, n=7$)

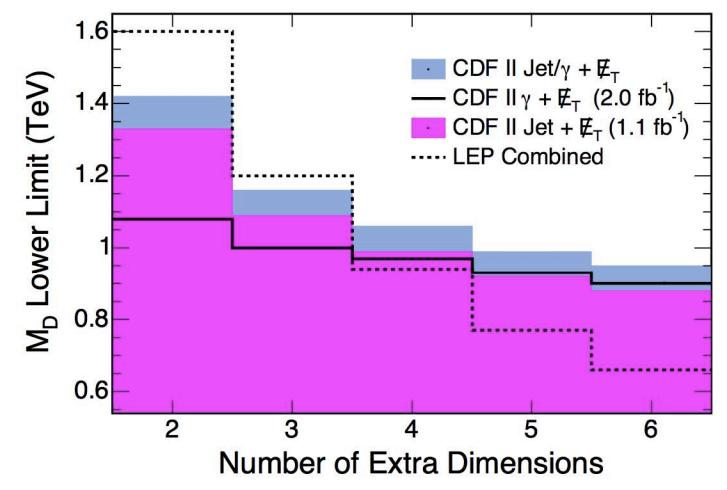
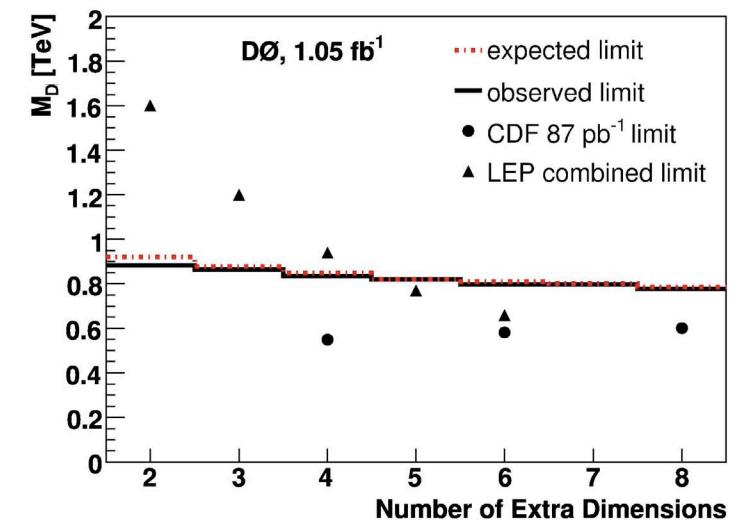
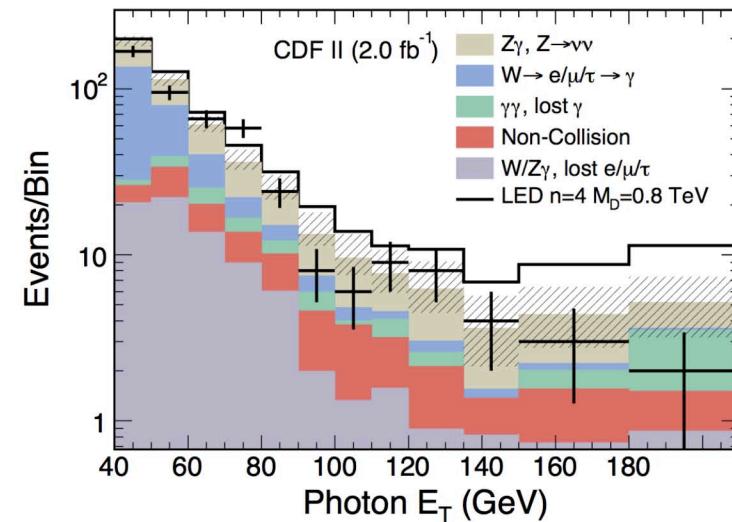
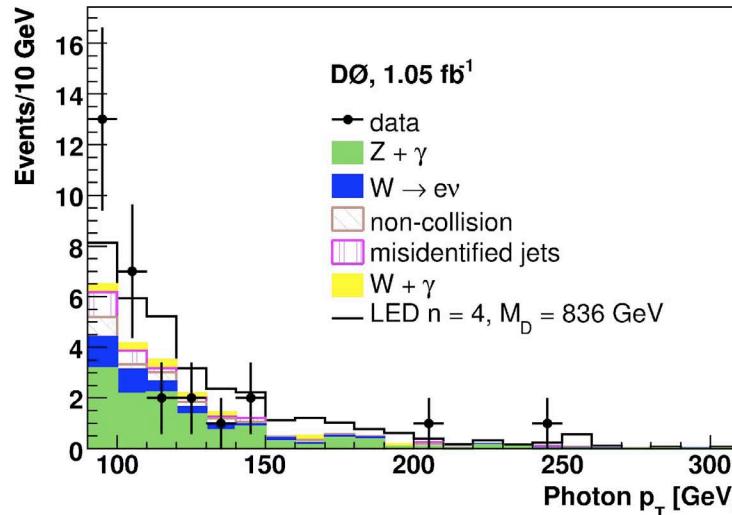
PHOTON/JET+MET SEARCHES

Signatures of LED, SUSY, etc.

DØ (photon + MET): no significant excess

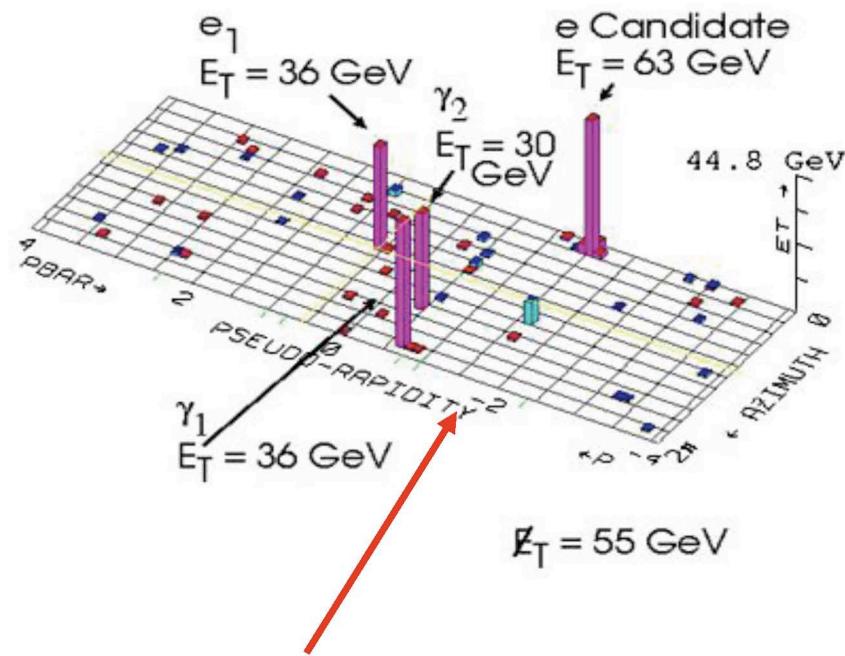
CDF (photon/jet + MET): no significant excess

Interpretation as $p\bar{p} \rightarrow G_{KK} \gamma$ (ADD)



DIPHOTON+MET SEARCH

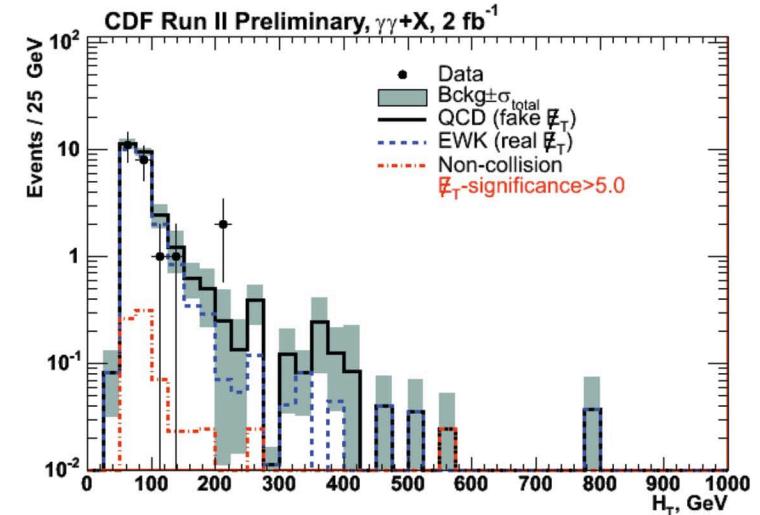
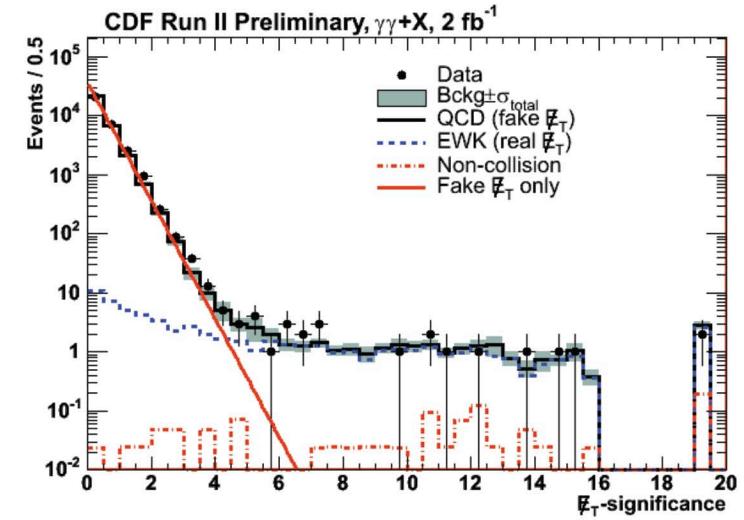
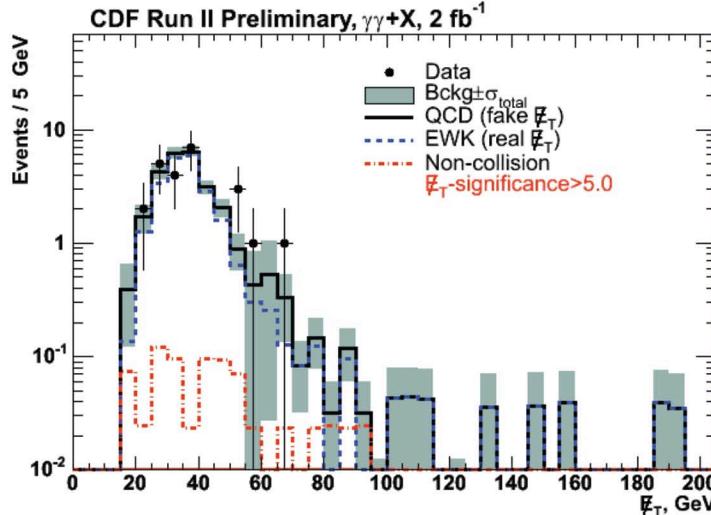
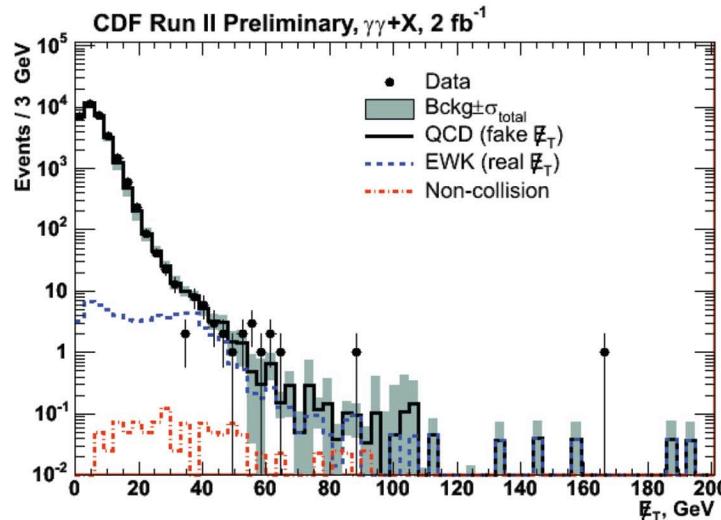
Signature of GMSB (see previous talk), extra dimensions, etc.



DIPHOTON+MET SEARCH

Signature of GMSB (see previous talk), extra dimensions, etc.
 Background is mismeasured QCD or W/Z+ γ , jets

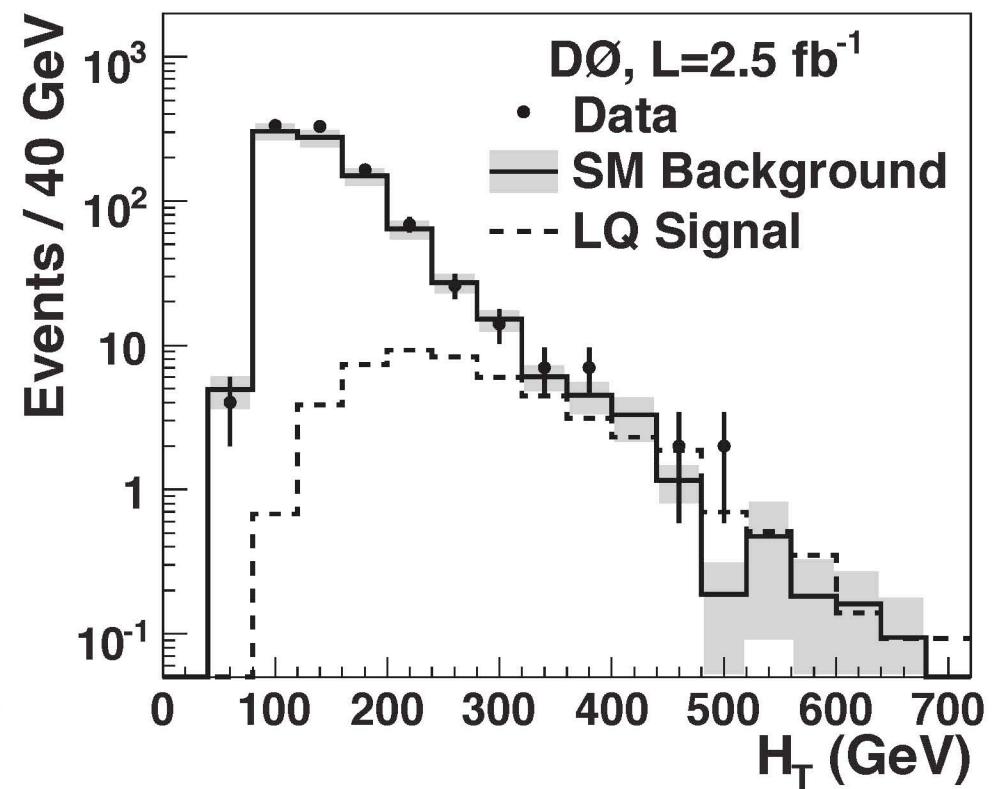
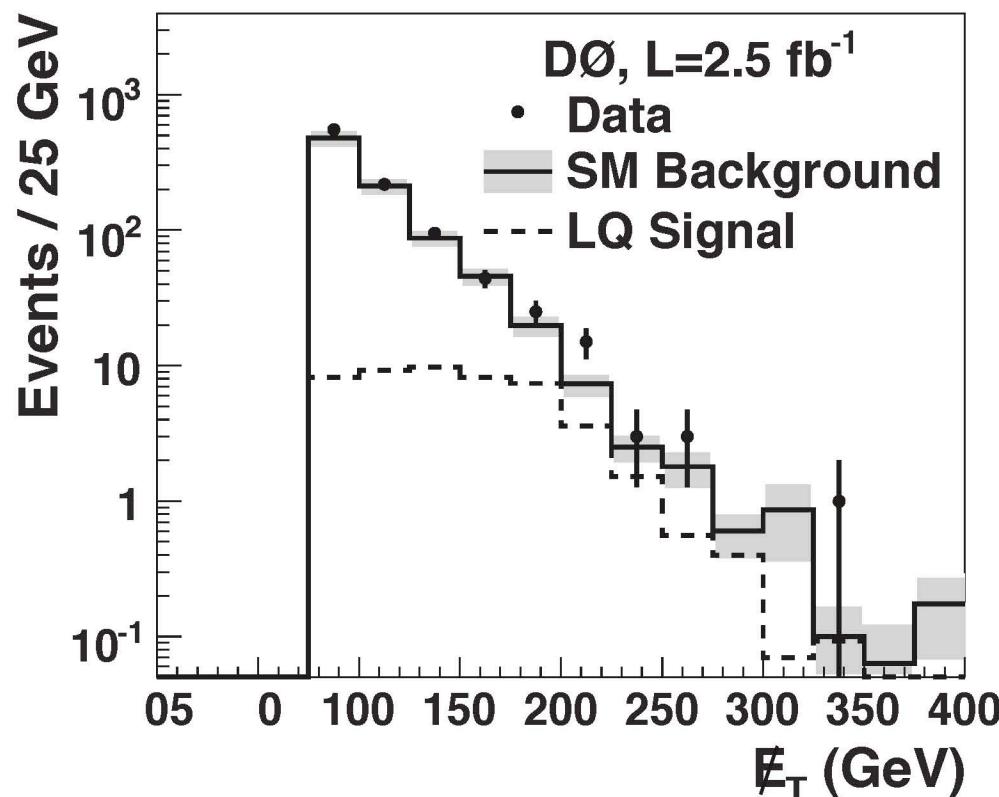
CDF (two photons + MET): no significant excess
 (e.g. 23 observed vs. 27.3 ± 2.3 predicted for MET Sig. > 5)



JETS+MET SEARCH

Classic signature of SUSY (LSP), extra dimensions, etc.
Background is predominantly Z+jets

DØ (two jets + MET): no significant excess



JETS+MET SEARCH

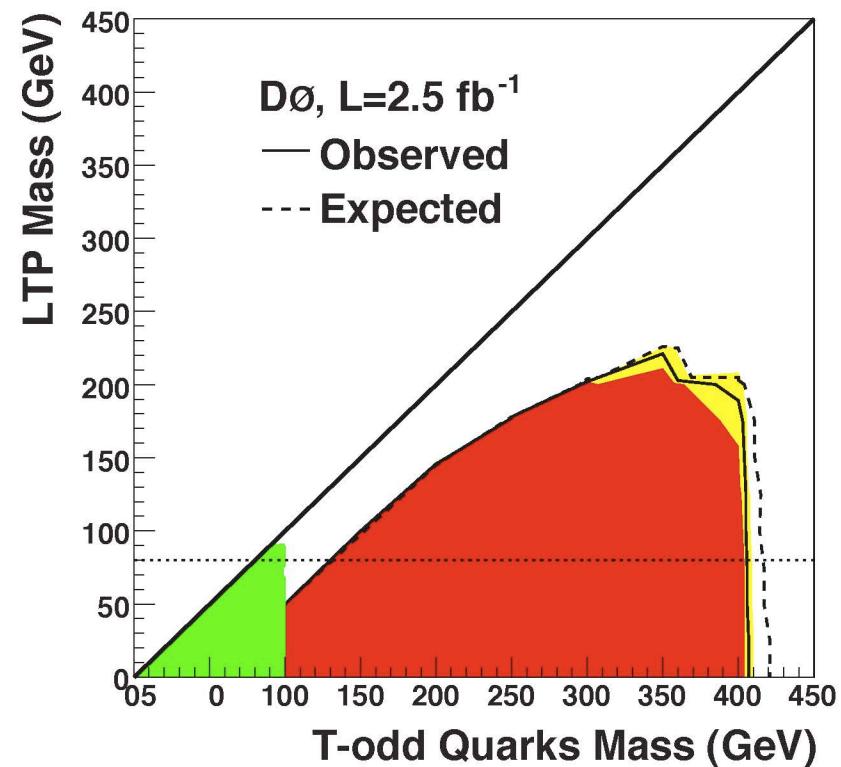
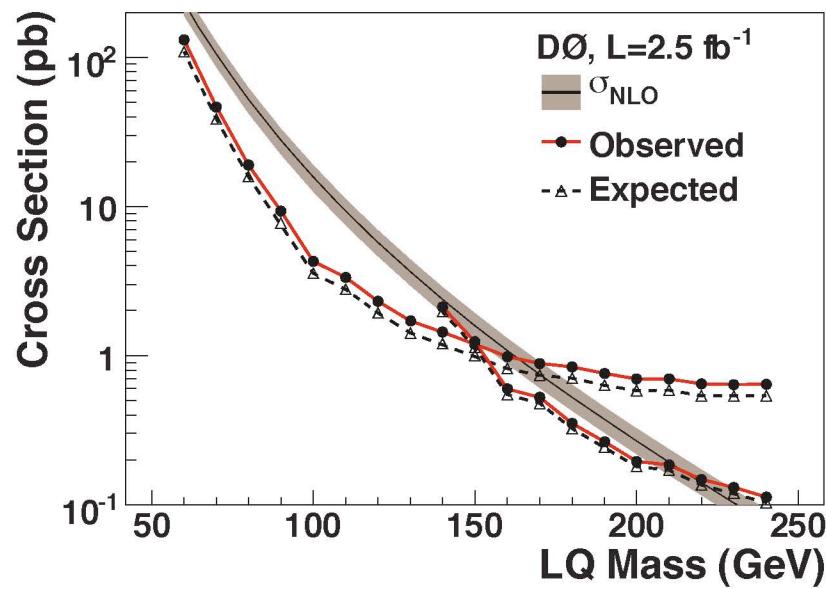
DØ (two jets + MET): no significant excess

Scalar LQ $LQ \rightarrow jjvv$

$M_{LQ} > 205$ GeV (2.5 fb^{-1} , $\beta = 0$)

$\tilde{Q}\tilde{Q} \rightarrow jj$ LTP LTP

$M_{\tilde{Q}} > 404$ GeV (2.5 fb^{-1} , Light LTP)



DIBOSON RESONANCE SEARCHES

Experimentally-motivated analog of Z' searches

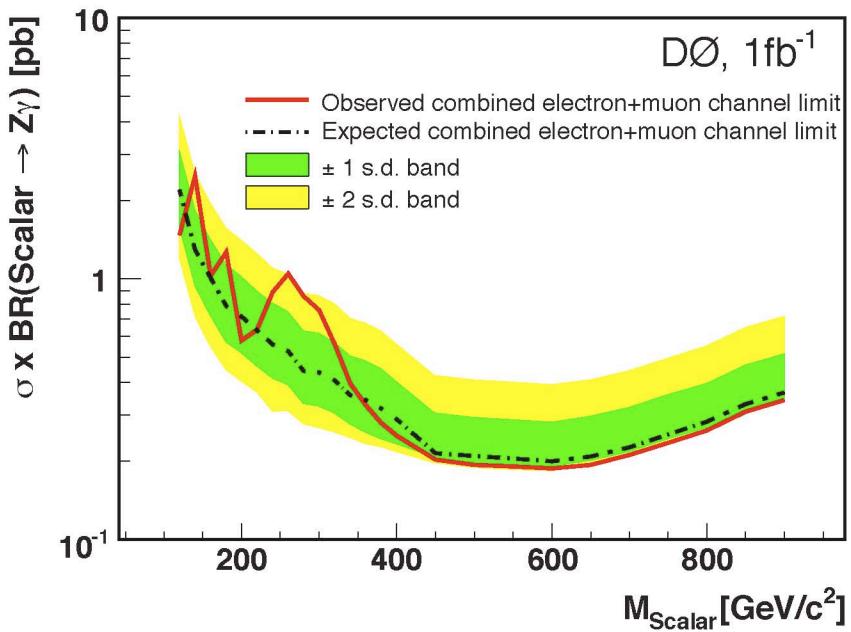
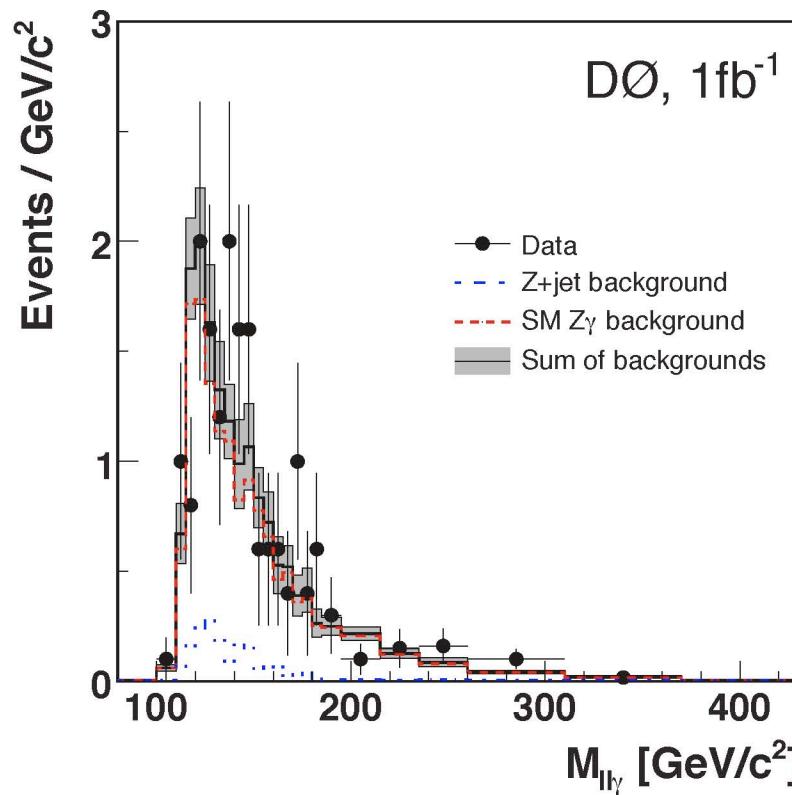
Same clean final states + mass constraints = small background

DØ ($X \rightarrow Z\gamma \rightarrow ee/\mu\mu \gamma$): no significant excess

Scalar [Vector] X

$\sigma \cdot \text{Br}(X \rightarrow Z\gamma) < 0.19[0.20] \text{ pb } (M_X = 600 \text{ GeV})$

$< 2.5[3.1] \text{ pb } (M_X = 140 \text{ GeV})$



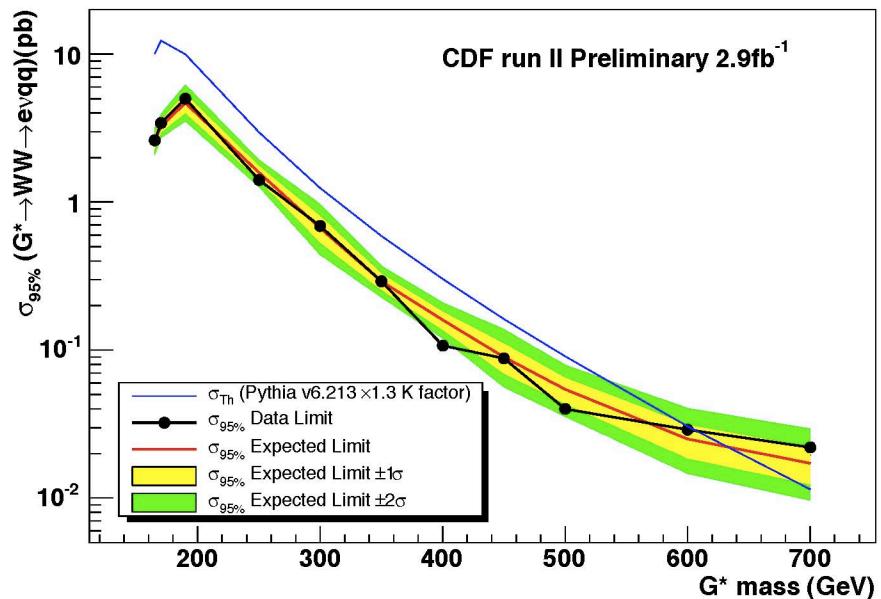
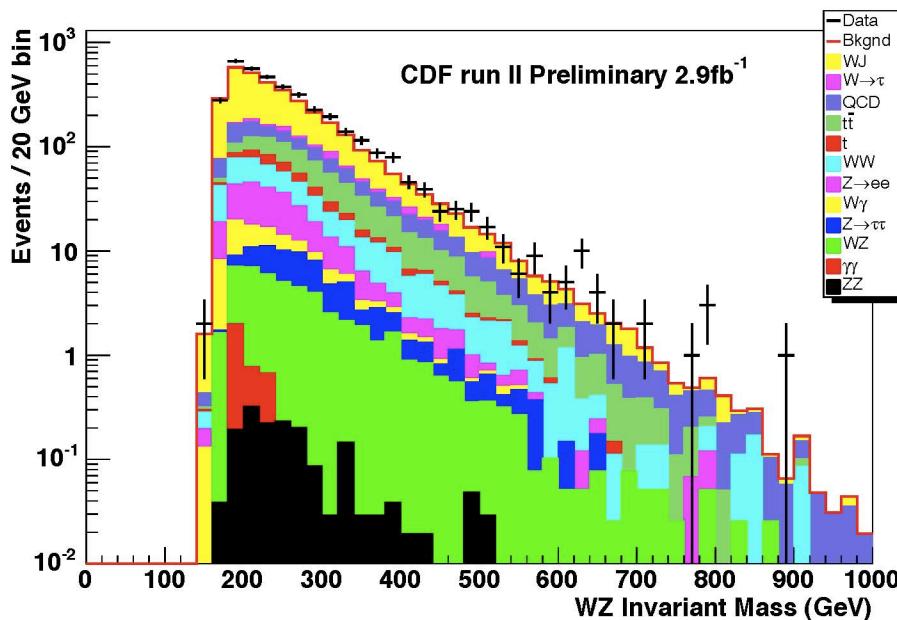
DIBOSON RESONANCE SEARCHES

Experimentally-motivated analog of Z' searches

Same clean final states + mass constraints = small background

CDF ($X \rightarrow WW/WZ \rightarrow e\nu jj$): no significant excess
⇒ set limits on W', Z', RS graviton

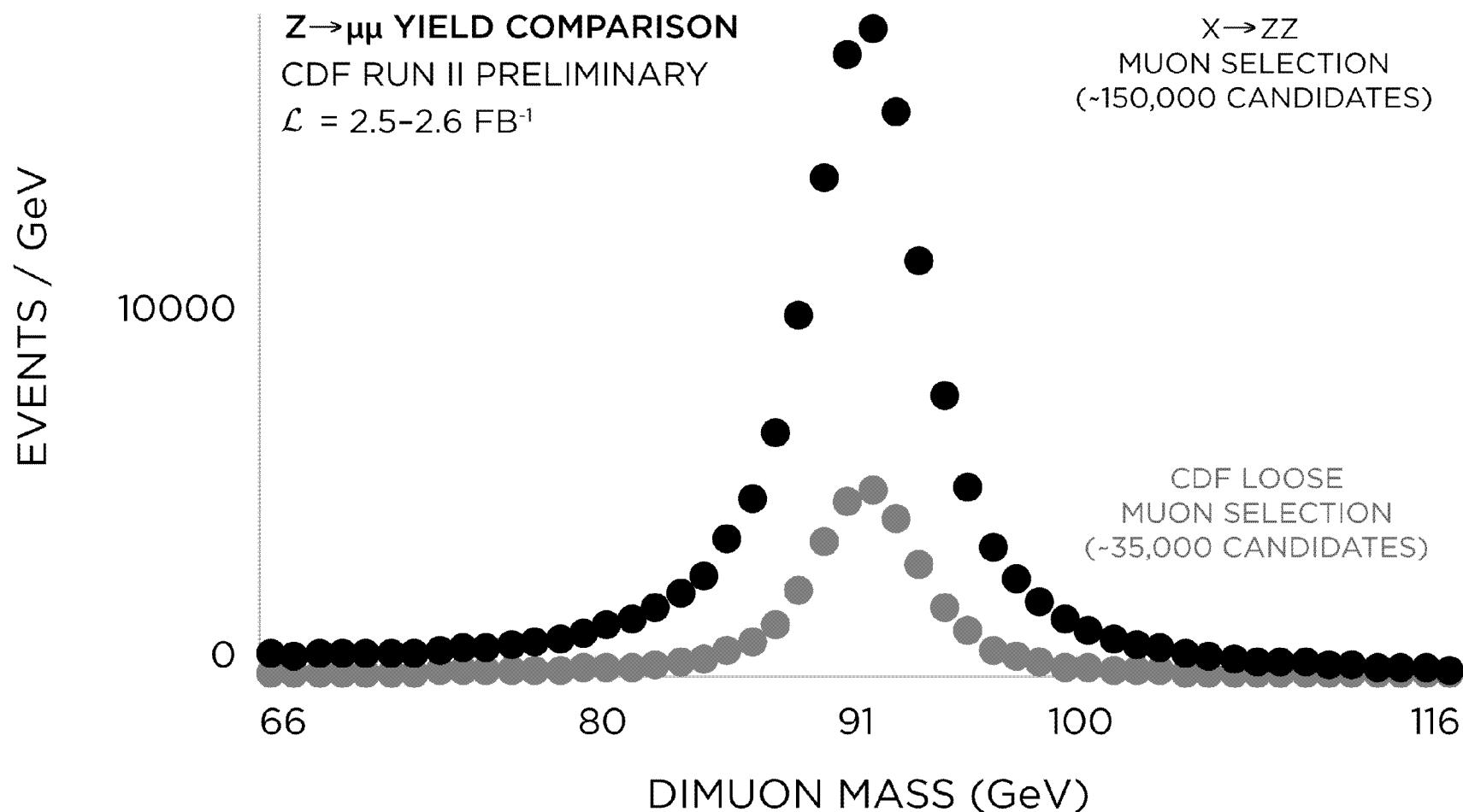
$$M_{W'} \notin (284, 515) \text{ GeV} \quad M_{Z'} \notin (247, 545) \text{ GeV} \quad M_G > 607 \text{ GeV} (k/M_p = 0.1)$$



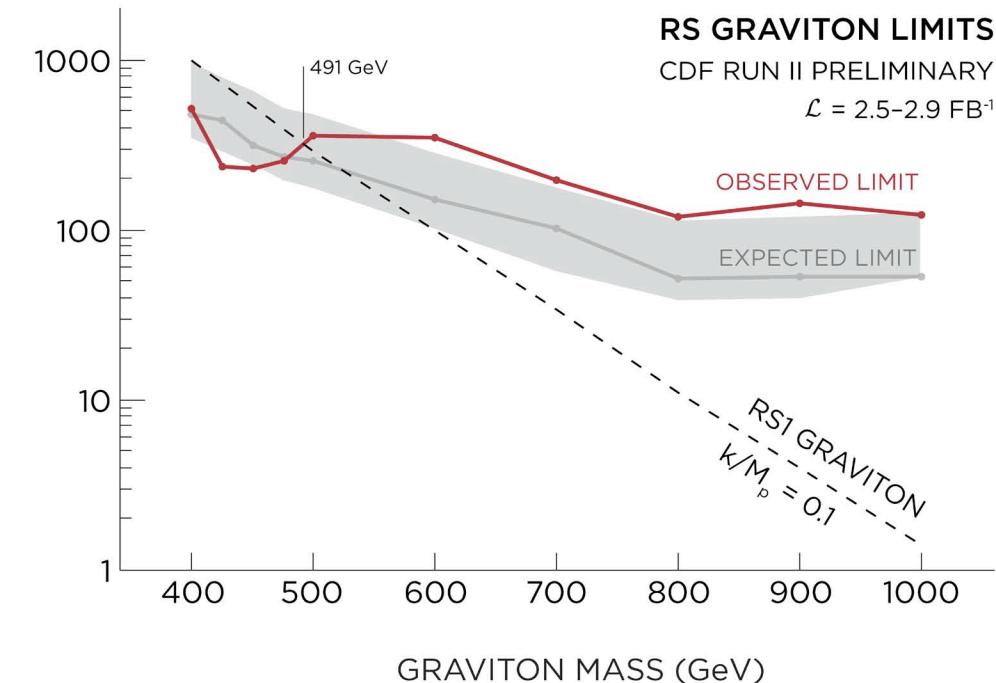
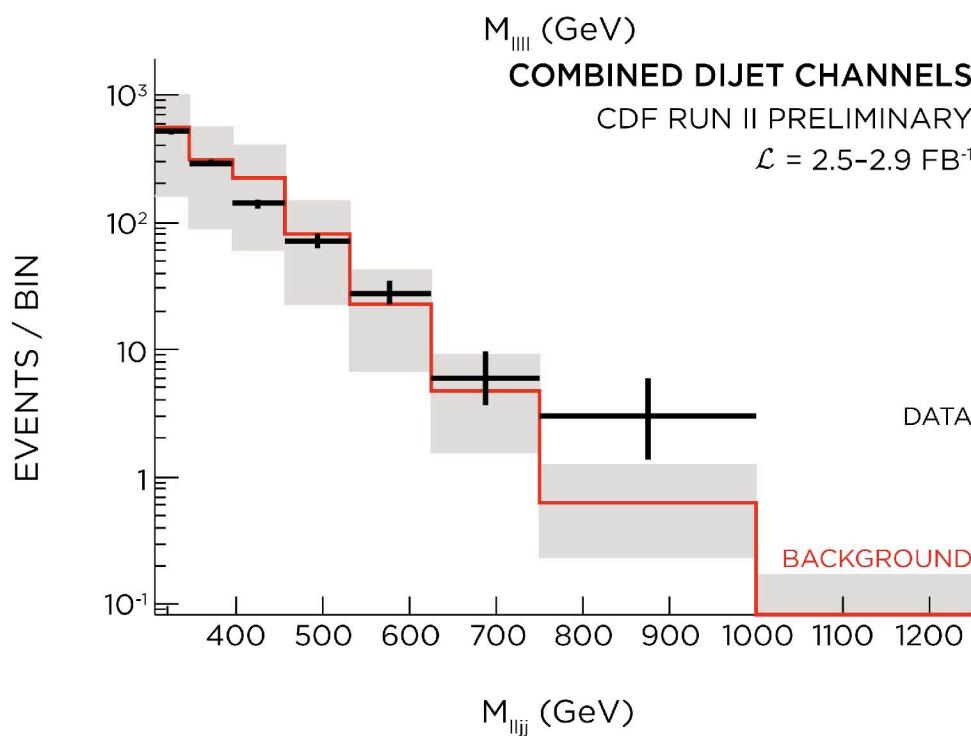
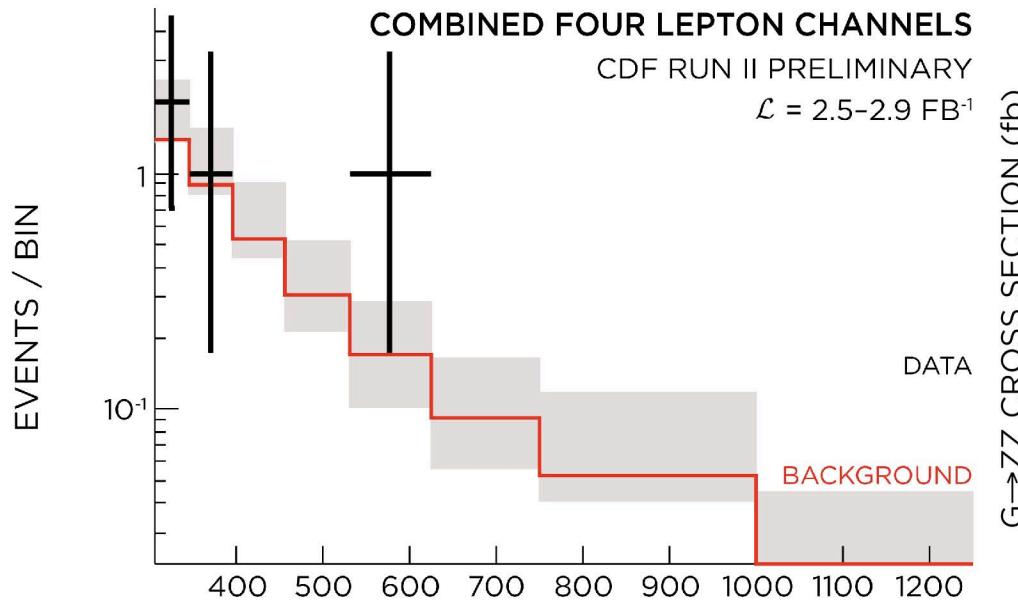
DIBOSON RESONANCE SEARCHES

CDF ($X \rightarrow ZZ \rightarrow llll, lljj; l = e, \mu$):

newly-improved forward track reconstruction
more efficient muon identification



DIBOSON RESONANCE SEARCHES



CDF ($X \rightarrow ZZ \rightarrow llll, lljj$; $l = e, \mu$):
no significant excess

RS (spin 2) $G \rightarrow ZZ$
 $M > 491 \text{ GeV}$ ($2.5\text{-}2.9 \text{ fb}^{-1}$, $k/M_p = 0.1$)

SUMMARY

Tevatron experiments have many searches for new physics

A few recent signature-based results presented today.

No substantive excesses in $1\text{--}2.9 \text{ fb}^{-1}$

At least twice as much data + better analysis techniques expected.
Several channels may yet see a significant signal this year...

Find these and future DØ and CDF results at

<http://www-d0.fnal.gov/Run2Physics/WWW/results/np.htm>
<http://www-cdf.fnal.gov/physics/exotic/exotic.html>